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Micrion

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Mr. Robert Reams
Harry Diamond Laboratories
2800 Powder Mill Road
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Dear Bob:

This is the 12th bimonthly report detailing work done on contract N00014-89-C-2238 during October and November, 1991.

3.31 Advanced Column Development

Advanced column development is essentially complete as of December 1991. Several columns(one of which is designated to go on the 0.25 um repair system) are running and are being tested and used daily. They are used for high resolution imaging as well as milling and deposition of tungsten. The X-ray column will be installed on the 0.25 um system as it is being assembled in January and February. We designed and built a new source assembly which has worked well without a problem, and is being lifetime tested presently.

Final items to be addressed are automated focus, stigmation, and alignment routines. Algorithms have been written and will be tested this month. We have not had high voltage problems associated with the X-ray column.

3.32 Repairs

Edge analysis software was completed and tested. Preliminary data shows that day to day, the standard deviation or repeatability of the system is <0.01 um, although the mean of the standard deviation over several days is not as good. Sources of error in the edge shift may be due to the method of measurement(discussed in the next paragraph), the inherent roughness of the gold grains leading to nonuniform sputtering, using the commercial ion column which has a larger beamspot size than the Micrion X-ray column, and internal redeposition. We plan to change the scanning strategy to reduce internal redeposition.

Further, we are measuring the repair placement manually off of an SEM photo. We are going to begin analyzing the data using CD(critical dimension) software which is installed on the JEOL SEM. Also, the SEM is equipped with TSEM(Transmission SEM) mode which will allow us to measure the data using a technique which may have less error due to scattering than using the standard CD linescan mode. This is a technique described and developed by Mike Postek and associates at NIST.

3.33 System Stability
We completed preliminary vibration testing on the advanced column and the column appears to be quite stable and not a prime contributor to overall system vibrations. Further we have not seen discernable drift problems associated with the column.

3.34 Electronics
Most of the electronic subsystems for the 0.25 um repair system including boards, harnesses, and chassis, have been designed, built and are ready for system integration. We are currently designing the lingen, or raster generator, electronics.

The ion beam is rastered over the sample surface and the pattern in which it is rastered is controlled by the raster generator. One is able to specify the beam dwell time per pixel, the distance between 'dwell' times, and the time the beam spends 'retracing' to a point, as well as frame sizes and shapes.

We are designing new raster generator electronics which, in addition to performing the above functions, will provide for unique scanning strategies and for fast (10 MHz) electronics capable of stepping the beam faster than 0.1 um per pixel. These functions are currently not supported by our existing hardware and will allow us to try different scanning strategies for repairing 0.25 um X-ray masks.

3.35 Software
Software development has occurred in three areas, specifically the completion of a 0.5 um mask repair users package, inspection data transfer interface, and definition and completion of many components of 0.25 um architecture.

We have completed a software package which will allow a user who is not intimately familiar with our system to routinely and semiautomatically repair 0.5 um X-ray masks after a short training period. It is in place if a user from the X-ray community wants to use the machine to repair X-ray masks.

Using enhanced mode 1 file transfer protocol, Micrion has demonstrated data transfer. This mode uses a single reference point coordinate system correlation and is complete. Data transfer from UVIS to Micrion's 0.25 um system will use a three reference point coordinate system correlation and is under development. Micrion is combining three sets of reference point data into one data file and will then test that tape.

Finally, we have completed and tested many of the software components required for the 0.25 um system, including support of various devices, diagnostic routines, beam control, automated power up and calibration of both the ion and electron flood beams, and a

rudimentary repair program. These components will allow system integration to occur in a straightforward manner and will provide a platform for 0.25 um repair process development. We are currently completing parts of data transfer (and more will be developed as KLA development occurs), automated mask insertion and removal, and support for the raster generator electronics described in task 3.34.

We plan to begin assembly of the 0.25 um repair system during the next two months.

Enclosed is a reprint of a paper on focused ion beam induced deposition published in JVST B. Part of the work was done under contract N00014-89-C-2238.

Sincerely

N K Stewart

Diane K. Stewart
X-ray Program Manager

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